Liquid Tin corrosion on structural materials for Liquid Metal Divertors

S. Cataldo,¹ M. Iafrati,² A. Antonelli,¹ M. L. Apicella,² S. Bassini,¹ M. Cornale,³ G. Giacomi,² G. Mazzitelli,² S. Rueca

¹ENEA - C.R. Brasimone, Bacino del Brasimone, 40032, Camugnano, BO, Italy
²ENEA - C.R. Frascati, Via E. Fermi, 00044 Frascati, RM, Italy
³Università di Roma Tor Vergata, Facoltà di Scienze, Via della Ricerca Scientifica 1, 00133 Roma, RM, Italy

 Plasma-surface interactions in Tokamaks are crucial for the efficient operation, safety and lifetime of a fusion reactor. In particular, liquid metal divertor (LMD) design seems to be very promising since liquid metals as plasma facing materials behave like self-healing surfaces against heat and irradiation damages. Unfortunately, they exert corrosive action on structural materials that should be properly chosen and/or effectively protected by anticorrosive coatings. In order to optimise LMD design, we are focusing on liquid tin, which is one of most promising candidate elements. Several aspects of the PFC design, applied structural materials, operation parameters should be considered taking into account the physical-chemical properties of Sn. Structural material such as stainless steel (AISI316, T91) or copper alloy (CuCrZr, W-Cu 80-20), and pure refractory metals (Ta, Mo, W) have been tested. Tests have been performed, in vacuum or in inert atmosphere, exposing such material to the tin corrosive attack in a wide range temperature 400°C – 1200°C. SEM, EDS and mass loss analysis results will be presented for these materials.

Possible coating solutions to prevent the corrosive attack, using tungsten or alumina, are proposed. Many deposition techniques such as plasma-spray or detonation-gun have been considered. Tests on coatings are actually going on, the experimental results will be shown addressing the main technical difficulties, advantages and disadvantages for the considered depositions strategy.

A linear mock-up of the LMD has been built using AISI 316 and CuCrZr. A new one is under construction using W-Cu. An extensive description for the mock-up design chooses in terms of compatibility with the liquid tin will be given.

This work has been carried out within the framework of the EUROfusion Consortium and has received funding from the Euratom research and training programme 2014-2018 and 2019-2020 under grant agreement No 633053. The views and opinions expressed herein do not necessarily reflect those of the European Commission.